Space Weather Technical Forecast

Issued on Wednesday, 15 February 2023 at 00:47 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further isolated M-flares (R1/R2 Radio Blackouts) likely, with a slight chance of isolated X-flares (R3 Radio Blackout).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the last 24 hours, with two low level M-flares from AR3226 (Dki/Beta-Gamma-Delta) in the northeast quadrant, and AR3213 (Fai/Beta-Gamma) now departing across the northwest limb.

There are currently 12 sunspot regions on the visible disc. The most noteworthy region currently is AR3226 in the northeast, which has continued to mature after previous rapid development. A very small delta spot appears to be present in the intermediate portion. AR3213, which has a history of flaring, is transiting over the northwest limb, leaving just the rearward trailer spots still visible. AR3214 (Beta/Esi), a moderate size group, has been fairly stable and this region is now approaching the west limb. Most other regions are either small and magnetically simple or relatively stable.

No Earth-directed CMEs have been observed in available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: There has been an outage of solar wind data since 13/2330 UTC. However, a weak CME arrival was observed starting around 13/1705 UTC. Wind speeds were at ambient levels, varying between 330-370 km/s. The density was predominantly at average levels. Total IMF, Bt, was weak but jumped from 2nT to around 5nT. The north-south component varied weakly between +3/-2 nT. The Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2). After 13/2330 UTC, it seems likely that largely ambient conditions continued, perhaps with some continuing weak CME effects, as the geomagnetic activity remained Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 remained at background levels. The high energy electron flux (greater than 2MeV) measured by GOES-16 was initially at High levels, peak of 1390pfu at 14/0120UTC, but soon dropped to Moderate. The associated 24-hour electron fluence was just above the Active (1e8 integrated pfu) level, peak 1.41e8 integrated pfu at 14/0900UTC, but dropped below the Active threshold by 14/1800UTC, and continues on a downward trend at present. The fluence at 15/0001 UTC was 4.88e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain Moderate, with further isolated M-class flares. There is a slight chance of becoming High with any isolated X-flare.

Solar Wind / Geomagnetic Activity: Earth has experienced weak CME effects recently. There are no significant coronal holes in the forecast at present, so the solar wind speed is most likely to remain at largely ambient levels. There is the possibility of weak High Speed Streams (HSS)

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pushing wind speeds to slightly elevated levels at times between Days 2 and 4, but this aspect is low confidence.

Geomagnetic activity is expected to be Quiet to Unsettled, perhaps with a low chance of rising to isolated Active between Days 2 and 4 should we observe any weak HSS effects.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels, but with a slight chance of exceeding S1 in response to any significant flares. High energy (greater than 2 MeV) electron flux is expected to be Background to Moderate with an overall declining trend through the period. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 integrated pfu), with a similar downward trend.

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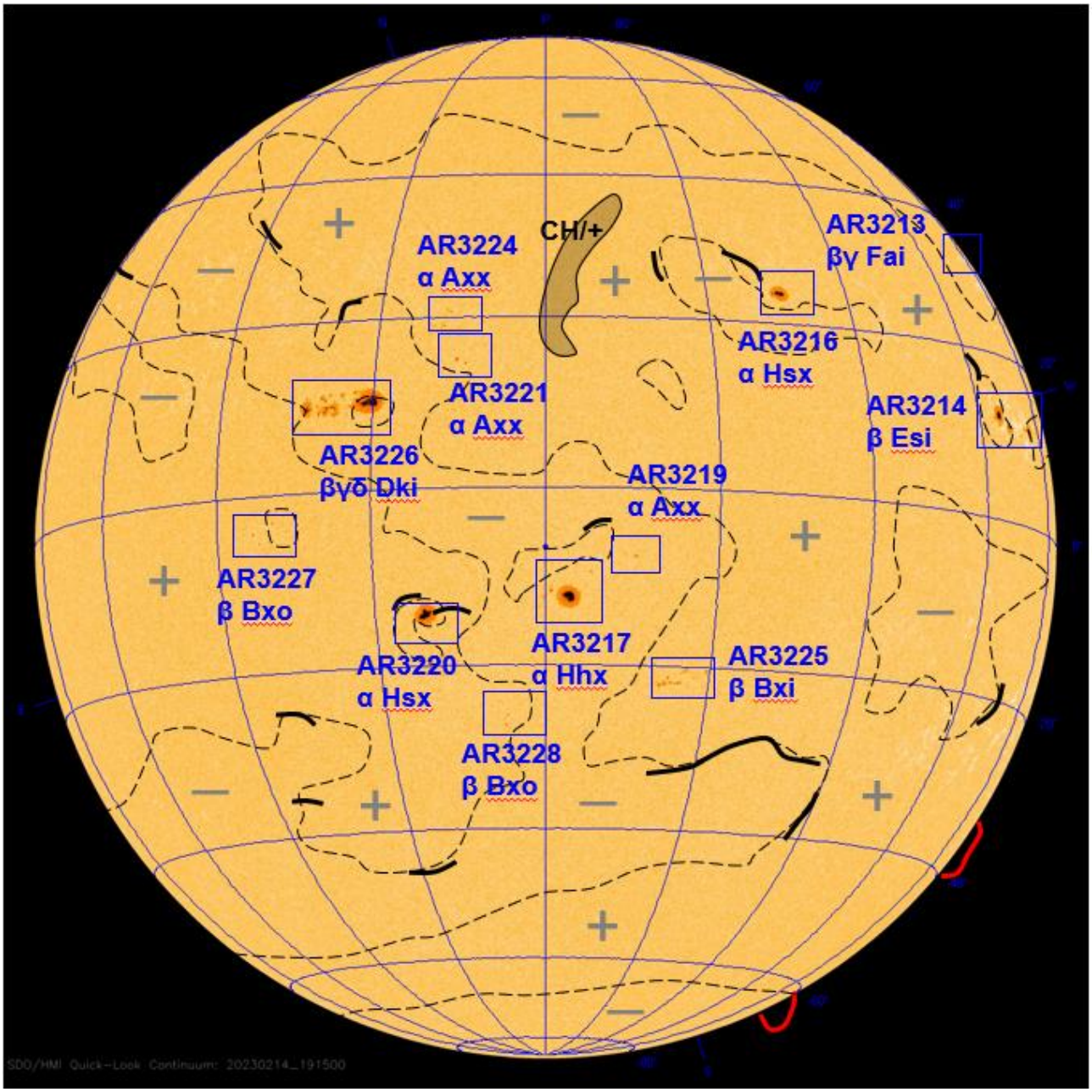
Figure 1. Solar Analysis Valid 14/1930 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There was a gap in solar wind data between 13/2328-14/1254UTC. However, data prior to this appeared to indicate weak CME interaction was likely to have continued into the overnight (UTC) period 13th/14th, with possible further weak CME interaction looking likely to have occurred over the past couple of hours.

There are no significant coronal holes in the forecast at present, so the solar wind speed is likely to remain at largely ambient levels. Enlil is suggesting a High Speed Stream (HSS) arrival on Day 2 (16 Feb), and on the previous rotation there was a HSS on the equivalent of Day 3 (17 Feb). However, imagery suggests any remnant coronal hole is very weak and less obvious than the previous rotation, so it is unlikely to give significant wind speed increases. Also, there is another weak possible coronal hole feature near centre disc in the north, which could potentially give some small enhancement to solar winds toward the end of the period. Therefore, it is possible that wind speeds could reach slightly elevated levels at times between Days 2 and 4 (16th and 18th), but this is low confidence.

Geomagnetic activity is expected to be Quiet to Unsettled, perhaps with a low chance of rising to isolated Active between Days 2 and 4 should we observe any weak HSS effects.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None expected.

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Radio Blackouts - X-Ray Flares:

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There are currently 12 sunspot regions on the visible disc. The most noteworthy region currently is AR3226 in the northeast, which has continued to mature after previous rapid development. A very small delta spot appears to be present in the intermediate portion. AR3213, which has a history of flaring, is transiting over the northwest limb, leaving just the rearward trailer spots still visible. AR3214 (Beta/Esi), a moderate size group, has been fairly stable and this region is now approaching the west limb. Most other regions are either small and magnetically simple or relatively stable.

Further isolated M-class flares are likely, with a slight chance of isolated X-class flares. A slight reduction in risk is indicated as regions AR3226, and then AR3214, rotate off the west limb. Far side seismographs and STEREO-A EUV imagery indicate that an active region of flux could reach the northeast limb later in the period, perhaps associated with a returning region.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	40	40
Very Active	R3 to R5 X Class	No	10	10	5	5

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Met Office Space Weather Technical Forecast

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. No notable high energy proton response has been observed from recent M-flares. Any further significant flares may increase count rates, with a slight chance of exceeding the S1 level. AR3213 (Fai/Beta-Gamma) is currently rotating off the disc. AR3217 has decayed significantly in the last couple of days and is considered unlikely to present a significant risk of a proton event in its current configuration. This leaves AR3226 as the main region that could provide a proton enhancement, however it is still located in a less favourable eastern hemisphere longitude at present. Therefore, a gradual decline in proton risk seems the most likely trend in the coming days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux at GOES-16 was initially at High levels, peak of 1390pfu at 14/0120UTC, but soon dropped to Moderate. Solar wind speeds have been mainly at background levels, with evidence of weak CME interaction both early and late on 14th. Wind speeds are likely to remain ambient or perhaps slightly elevated through this period, with any further significant charging unlikely. Therefore, flux levels are expected to gradually drop through the period.

The associated 24 hour fluence was just above the Active (1e8 integrated pfu) level, peak 1.41e8 integrated pfu at 14/0900UTC, but dropped below the Active threshold by 14/1800UTC, and continues on a downward trend at present. Observed values are now closer to REFM predictions, with the model forecast offering a plausible looking overall downward trend over the next 24 hours, although looks too low on days 3 and 4 (17th and 18th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	20	10	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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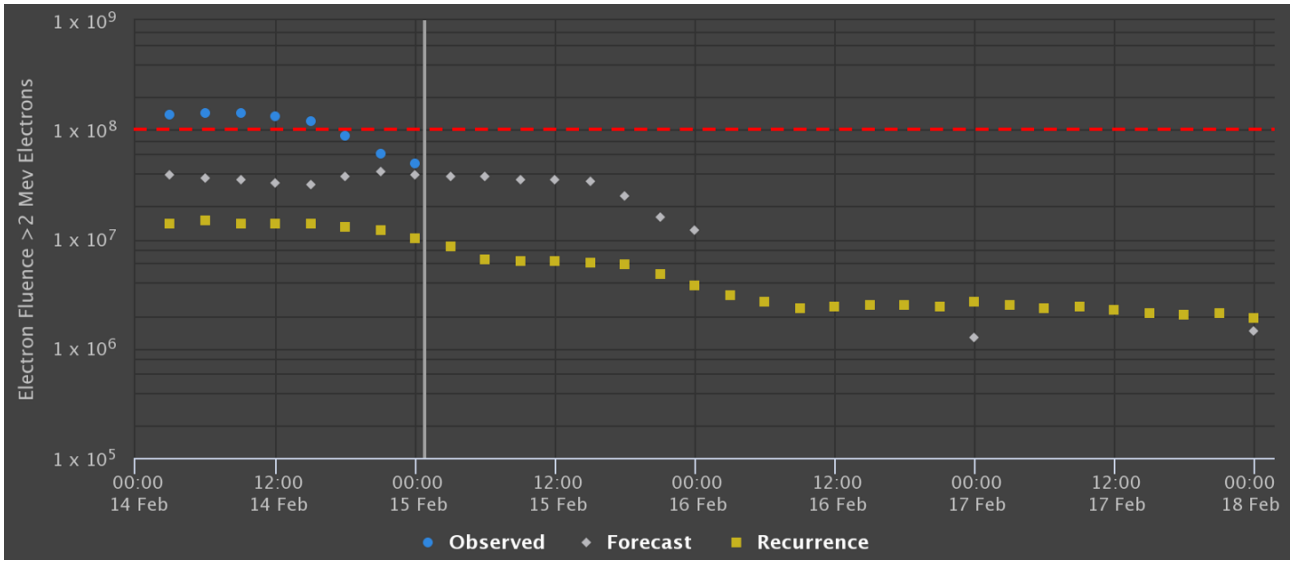
Figure 2: MOSWOC REFM.



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